Description

Carrier For Structural Parts

The invention relates to a carrier for structural parts to be subjected to a heat-treatment process, comprising at least one frame and a lattice extending therefrom comprising intersecting strands, the frame consisting of one or more limbs, which preferably form a polygon, and the frame comprising temperature-resistant material and the strands, extending from the limb or pieces of the frame to form the lattice, comprising carbon fibers or ceramic fibers.

To position or fix slim metallic or ceramic structural parts and components during heat-treatment processes, they are inserted into holding frames. Heat-treatment processes are, for example, sintering processes, hardening processes, finishing processes or soldering processes. Usual processing temperatures are between 700°C and 2600°C, whereby one typically works at between 800°C and 1600°C.

According to the prior art, frames having such lattices comprise metal. The lattices are thereby formed by strands in the form of rods having e.g. a diameter of 2 mm. However, such holding devices exhibit considerable disadvantages which can be seen, inter alia, in the following:

- distortions during thermal cycles,
- creep of the entire structure due to the effect of temperature,

- high dead weight,
- high heat capacity,
- short life due to embrittlement,
- high cost of adjustment to extend useful life,
- increased waste of the parts to be treated due to distortion of the holding device.

Due, particularly, to a reduced shape stability, problems are often caused in loading or unloading such holding devices by means of manipulators such as robots.

A fibrous composite part having a lattice-like structure which is used in high-temperature furnaces and system construction, in heat-treating technology or sintering technology as a grate, is known from DE-A 199 57 906. A fiber preform, which is produced especially according to the TFP (Tailored Fiber Placement) technology and then pyrolyzed, i.e. carbonized or graphitized, is used for the production.

A carrier for hardening material is described in DE-U 295 12 569. In this case, the carrier comprises carbon fiber-reinforced carbon material (CFC material) which can have a protective layer consisting of SiC, BN or TiN. The carrier comprises limbs that can be interconnectyed and have recesses that are aligned to one another through which the material to be hardened is passed.

A workpiece carrier for heat-treating workpieces is known from DE-A 197 37 212. The workpiece carrier may comprise a single-piece monolithically formed frame on which bent rods can be

placed which are used to accommodate workpieces. According to a further embodiment, the carrier comprises a tubular construction about which the fiber bundles are wound, the fiber bundles extending at a spacing from one another.

A lattice-like carrier made of a ceramic material is known from JP-A 2000 304459 which has the form of a ceramic weave consisting of a frame and a lattice clamped and held thereby.

To produce a lattice according to EP-A 0 560 038, a form having a groove is provided into which the fibers are placed in order to then be hardened under pressure.

A carrier basket made of metal for accommodating structural parts which are being subjected to a heat-treatment process is known from US-A 2,962,273.

The object of the present invention is to further develop a carrier of the aforementioned type in such a way that a distortion-free carrier is provided even under strong thermal loads or fluctuations in temperature in order to be able to subject structural parts to a heat treatment to the desired extent. According to a further aspect, it should be ensured that contact reactions between the components to be treated and the carrier or lattice are avoided. It should be possible to produce the carrier or lattice itself with structurally simple steps.

According to the invention, the object is essentially solved by a carrier of the aforementioned type in that the lattice is

formed by a section of an endless fiber bundle in the form of single-layer or multilayer fiber strands or intertwined yarns of carbon-reinforced carbon material and/or ceramic material extending between limbs of the frame, the fiber bundle extending in a warp and woof-like web structure between the limbs of the frame. This produces a coarse woven structure whose mesh size can be individually designed in order to accommodate parts of any desired size.

If the frame consists of a single limb, then that limb has a curved shape in order to form e.g. an oval or a circle.

The carrier may comprise a single frame or of several frames extending at a right angle or parallel to one another which more or less combine to form a basket that is open on one side.

Independently hereof, whether single-layer or multilayer fiber bundles or intertwined fibers or yarns in the form of e.g. cords are used as fiber bundles which comprise carbon fibers or ceramic fibers, according to one embodiment the limbs of the frame have recesses on the longitudinal edges through which sections of the fiber bundle pass for extending the mesh. In particular, the recesses themselves form a comb-like geometry in the respective longitudinal edge.

Alternatively, there is the possibility that the limbs are provided with openings, such as borings, through which the fiber bundle passes. Depending on the position of the recesses or openings or their use, the mesh spacing, i.e. the mesh width of the mesh netting, can be varied in a simple manner.

Furthermore, it is foreseen that the fiber bundle, laid out in

the web structure, is tensioned between the limbs, as a result of which it is ensured that the finished lattice cannot sag, i.e. forms a plane.

In particular, Al_2O_3, SiC, BN, C or B_4C and/or combinations thereof are possible as material for the rovings or fibers.

Preferably, the frame comprises CFC, graphite or fibrous ceramic. The frame may have limbs produced by TFP (Tailored Fiber Placement) technology which can be joined together by plug-in connections. However, there is also the possibility of cutting a frame, e.g. by means of water jet, from a carbon fiber-reinforced carbon plate. Sections of such a plate can also be assembled to form a frame.

As long as the carrier has a more or less two-dimensional geometry, i.e. comprises a single frame with a lattice extending from its limbs, each limb should preferably form a plane which extends at a right angle to the plane formed by the lattice.